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THE HUMANIZING OF SCIENCE[1]

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NEW HAVEN, CONN.

IN the prefatory chapter of Dr. George Sarton's monumental undertaking,[2] there occurs the following statement: "The History of Science, being a new discipline, is not yet well organized or well circumscribed and attracts the attention not only of experienced scholars but of amateurs, dilettanti and cranks."

From which of these categories I have been elevated to this position of prominence I hesitate to enquire. It certainly was not from the ranks of experienced scholarship, nor have I any pretence even as an amateur historian. Though long active in what is said to be a scholarly profession, yet I would be put to it to tell just where the technique of medical practice—the art of medicine—leaves off and the science of medicine begins.

Both are essentially "humanistic" in its wider sense, in so far as the one is directed toward the alleviation of the diseases to which mankind is heir and the other toward their ultimate banishment. The chief difference between modern science and the natural philosophy of the ancients is said to lie in our greater inclination to put things to the test of experiment; and while medicine is constantly broadening its scientific background, in a certain sense every drug a doctor administers and every operation a surgeon performs is experimental in that the result can never be mathematically calculated, the doctor's judgment and the patient's response to his prescriptions being variables indeterminable by any law of averages. But this is far from making medicine a scientific calling.

That admission being made regarding the only subject with which I can claim familiarity, I must at once confess that I do not clearly perceive just where the humanities leave off and science in general begins, nor why in the schools any conflict should have arisen between them, for they spring from the same hellenic roots and seem so essentially supplementary.

Naturally on the part of teachers there is constant elbowing for the curricular recognition of their subjects and with energetic leadership emphasis from time to time may shift in one direction or the other.

[1] Presidential address before the History of Science Society, Washington, December 28, 1934.

[2] "Introduction to the History of Science." Carnegie Institution, Washington, 1927, Vol. I.

Thus at Oxford, the humanities have so long received the greater attention that one easily forgets the presence there in the thirteenth century of Michael Scotus, of Sacrobosco, of Robert Grosseteste, of John Peckham, and above all of Roger Bacon with his dictum: *Sine experientia nihil sufficienter scisi potest.* Then again in the seventeenth century under Wilkins, Boyle and Wren, Lower, Willis and Hooke, natural science was so ardently cultivated at Oxford that the Royal Society had its inception there. In Cambridge, on the other hand, the physical sciences since the time of Newton have been increasingly emphasized; and this same tendency now so far pervades most universities in our own country that the number of undergraduates who major in the classics appears to be constantly dwindling.

Yet those who ultimately take up whatsoever branch of science without some preliminary schooling in Latin and Greek unquestionably suffer a handicap. This is true, among many other reasons, in that our scientific terminology is almost wholly based upon these two languages; and consequently the special lingo that must be acquired, if not meaningless to the tyro without them, at least loses much of its real significance, flavor and interest. What is more, since the early scientific treatises were written in the same languages that constitute the *Litterae Humaniores,* there would appear to be no essential reason, apart from the subjects with which they happen to deal, why from a classical standpoint they are not as humanistic as what used to be called "polite letters."

All this goes to show that I do not know precisely what, if anything, the humanities have to do with humanism, or just what humanism is unless it concerns itself with the philosophy of man whereas the physical sciences deal with the philosophy of his environmental matter—what Professor Dewey would call Naturalism.[3] But the old-time natural philosophy went out—proudly, be it said—with the comprehensive "Kosmos" of the aged Humboldt, whose death, curiously enough, coincided with the appearance of "The Origin of Species" which may be looked upon as the beginning of the modern era of science with its wholly altered conception of man's place in the universal scheme of things.

The term "scientific" in these modern days has come to be much abused. Many things that are popularly looked upon as being scientific, and many persons who are said to look upon life from a scientific point of view, are no more scientific than an infant in its cradle, however much the child is in process of being brought up on so-called scientific principles with a pediatrist on one side scientifically to measure its vitamins and calories day by day and a psychologist on the other scientifically to protect it from complexes—perhaps even to provide an infant chimpanzee as a comparative playmate. Thus does the quasi-science of medicine sometimes lead to absurdities from which medical practice, largely controlled by common sense, usually escapes.

It is ridiculous that a doctor should be regarded as "scientific" merely because, having recourse to a few instruments of some considerable precision, he supplements his sensory impressions thereby, possibly puts a few of his observations or conjectures to the test of experiment and finally writes a paper or two on his deductions. He may even awake some day to find his name starred in "American Men of Science" when in his heart he knows that his supposedly scientific observations have been either disproved or reinterpreted almost before their appearance in print, whereas his true learnings are humanistic. At least he likes to think his instincts are humanistic—shall I say scholarly?—and yet, while so flattering himself, he is conscious of some uncertainty as to what, after all, the term really signifies. He is quite familiar with humanity—knows it, in fact, stripped to the skin—and his code of ethics emphasizes the Christian principles of philanthropy; but "humanism" appears to be something entirely different. It has become a word people conjure with.

Even after reading Irving Babbitt,[4] so bewildered have I found myself regarding the implications of the term I have felt obliged to seek aid from a scholarly friend and colleague. His interpretation, it appears, is restricted to the last of the four definitions given in 1901 by Gilbert Murray and his collaborators, *viz.:* a devotion to those culture-promoting studies, especially the Roman and Greek classics which came in vogue at the Renaissance. Insisting that this is in accordance with the usages of Varro and Cicero, my friend cites Aulus Gellius to the effect that *humanitas* in Latin is *not* φιλανθρωπια which is defined as *benevolentia erga omnes homines,* but that people who knew Latin and used it well "humanitatem appellaverunt propemodum id quod Graeci παιδειαν vocant, nos *eruditionem institutionemque in bonas artes dicimus. Quos qui sinceretur percupiunt ad petuntque, hi sunt vel maxime humanissimi.*"

Thus it would appear that even during the lifetime of Galen there may have been a tendency, against which Gellius protested, for the word *humanitas* to imply something more than literary culture just as in our own time, on the authority of the New English Dictionary, humanism more properly signifies a "de-

[3] John Dewey, "Humanism and Naturalism." Monroe's Encyclopoedia of Education.

[4] "Humanism: an Essay at Definition." Essays on the Outlook of Modern Civilization. Edited by Norman Foerster, 1930.

votion to human interests" or "the character and quality of being human" which comes very close to a concern for man's well-being on the one hand, and to φιλανθρωπια on the other.

I have gone into all this because of my somewhat enigmatic title "The Humanizing of Science" which may mean one of two things—(1) a revival of interest in the early classics that deal with natural philosophy, and (2) such an enlargement of the scientific outlook as to include in its scope matters which have to do with human welfare as something apart from culture and in the long run perhaps more important.

While a revival of appreciation for the literary and historical classics chiefly characterized the Italian-born humanistic movement of the Renaissance, it should not be forgotten that contemporary mathematicians and astronomers were for their special purposes finding the early classics of science no less remarkable and important as sources of learning. But the scientifically minded among the scholars of the day represented, as always, a minority and it was natural enough that the larger group, through the wider appreciation and understanding of the subjects with which they dealt, should have come to be regarded as the more cultured.

As typical representatives, the names of Erasmus and his English friends, More, Colet, Latimer and Grocyn, quickly come to mind and, among doctors, perhaps more particularly the name of Linacre, *philosophorum medicorumque facile princeps*—with the futile wish that one might have possessed some of his scholarly gifts.

While Linacre is said to have made his Latin translations of Galen from Greek codices in the Vatican, they were already well known through Muslim transmitters whose texts, though used in all the schools, were coming into disrepute as supposedly barbaric. Nevertheless, Albertus Magnus, according to Renan, owed everything to Avicenna as did St. Thomas Aquinas almost everything to Averroes; so possibly even Linacre in collating his Galenic texts may have had reason to lament his want of familiarity with a language which was of little use to the Renaissance students of history and literature. The Islamic scholars thought more of Hippocrates than Homer and were far more interested in the mathematics and natural philosophy of the Greeks than in their literary writings.

Of the seven liberal arts required for a doctorate those composing the *trivium* were probably more useful for a prospective doctor of medicine than were arithmetic, geometry, astronomy and music—the four mathematical disciplines of the *quadruvium*. Medicine consequently, though slow in being regarded as one of the learned professions, attracted during the Renaissance many humanistic scholars scarcely less notable than Linacre. Physic was taught as a branch of philosophy; and the ancient learning, though presented in the tongue universal to scholars of the day, was largely what the industrious Hunayn and others, copying from Greek codices, had passed along, in course of time to be laboriously set over from Arabic into none too good Latin.

The hand of Aristotle with the commentaries of Averroes lay heavy on philosophical thought for a period of four centuries; but the fact that the peripatetic teachers of the Lyceum were keen observers and had dipped so deeply into mathematical, physical and biological subjects that their era may well be looked upon as "the heroic age of science,"[5] has been all too much neglected by humanistic scholars of recent times.

The value of Greek and Latin as a cultural discipline began to be undermined so soon as the exercises —as many of us to our sorrow remember—began to be largely philological and pedantic in character. But over-emphasis on classical learning even during the Renaissance sometimes led to absurdities, as when in Toulouse and elsewhere there developed a Ciceronian cult against whose pompous style in writing and diction Erasmus winged one of his barbed shafts. It however was dangerous to be too knowing and to express ideas that might be taken as adverse to the accepted dogmas of the church even when couched in the Ciceronian style which Dolet cultivated.

And if this was true of the literary humanists, persecutions for heresy were far more likely to strike at those who dabbled with science and formed opinions about cosmogeny and natural phenomena that ran counter to the book of Genesis. Copernicus died before the Inquisition could call him to account for publishing the "De Revolutionibus," while for upholding the views it expressed Giordano Bruno went gallantly to the stake and Galileo's abjuration alone saved him from a like fate.

The restriction of humanistic culture to those classics possessing literary and historical worth can be envied since their message from generation to generation is not subject to change. The classics of science, on the other hand, while just as ancient, deal with concepts that continue to be in a constant state of flux. This is particularly true of the physical sciences for despite their supposedly precise laws, expressible in complicated symbols, it takes a mathematical genius to keep up with the shifting approaches of astronomers and physicists toward a solution of the great riddles of space, time and the atom. Meanwhile space gets ever larger and particles ever smaller.

Those of us who have clung to the belief that

[5] William A. Heidel, Carnegie Institution Publication No. 442, Washington, 1933.

nature abhors a vacuum and that Archimedes knew what he was about in regard to π being 3.1416 are told that all such old-fashioned ideas which failed to take time and the quantum theory into consideration are completely outmoded. But who were Pythagoras and Euclid and Aristarchos and Archimedes and Apollonius and Hipparchos, to mention only a few of those who left their names stamped on mathematical science long before the heyday of Rome? In my youth Euclid was the name of a street in Cleveland, Ohio; and then I had of course heard it rumored that Archimedes once got a new idea in his bath—which explained why plumbing was so often hopefully labelled Eureka.

Partly as a sop to my humanistic yearnings and partly in the vain hope of stimulating my unmathematical mind, I once purchased a copy of Radolt's famous edition of Euclid's "Elementa" in a monastic binding. Possessing that, I could not resist another scientific landmark, the "Principia" of Newton, when a copy happened to come within reach. Here then on my shelves, if not in my head, were scientific treatises as an evidence of my respect for a branch of knowledge whose theorems and mathematically expressed formulae would supposedly endure for all time.

This anticipation, however, was soon shattered by Einstein whose original paper on relativity I was impelled to secure; and though none of it could be understood, a mathematical colleague assured me that it unquestionably represented the last word. But no such thing! The chief justice of the High Court of Allahabad has just succeeded, it is said, in reducing the equations of both Einstein and Newton to such simple forms it can be demonstrated that time slows down with distance. In other words, it can now be mathematically shown that if A and B are twin brothers and B makes a journey, B must be younger on his return than A. Doctors of course have long been aware of the practical truth of this and it explains their custom, when put to it to tell what is wrong with a patient, to suggest travel and change of scene as favorable to longevity.

Thus while modern physical science makes headlines for itself so fast there is difficulty even for experts to keep up with it, Sir James Jeans publicly acknowledges that photons, electrons and protons, though their properties can be expressed mathematically, are really as meaningless as x, y and z to a child on its first lesson in algebra; and it has been admitted by someone else that the advance of physical knowledge is at present reduced to the extraction of one incomprehensible from another incomprehensible. Yet we are assured that the mathematical starting point for all this was Hero's synthesis of the two laws of Euclid which have merely been expanded by Newton, Einstein and Sulaiman to embrace all the activities of the universe.

Though beyond the comprehension of most Renaissance humanists, the impact of the ancient treatises dealing with mathematical subjects certainly had a no less marked effect on the progress of human thought than had the classics of history, philosophy and literature; and it would seem therefore that some familiarity with their purport at least should be as much a part of the fiber of a classical education as the writings of Homer, Virgil, Horace and Cicero.

Historians, generally speaking, either from want of understanding or lack of interest have rarely laid stress on the manifold ways in which science and its applications have modified world events and affected human society. But since these effects are becoming rapidly accumulative, their consideration by historians will be more and more inevitable as time passes. The last great war was precipitated apparently by political rivalries but in its conduct it was clearly a war between the mobilized scientists of the contending parties, for they alone were in a position rapidly to increase the effectiveness of its destructive agencies and in an emergency to devise means of defence against such novel forms of destruction as might be introduced by their opponents. It was a sorry business to throw in the lap of Science, though stimulated by the responsibility Science doubtless has profited by it in many ways.

But as political historians know better than most others, the almost invariable aftermath of war is a temporary wave of apparent prosperity followed by a more or less prolonged period of economic depression with its social disorders, prevalence of crime, licentiousness and unemployment. On these now urgent and world-wide problems Science does not as yet appear to have put its mind—or if it has, it has not offered any solution to the problem. Society in the interval restlessly endures the situation as best it can, and it is left to time and politicians to find a way out.

Meanwhile, a very curious and unexpected thing has happened. Science to the average man has become suspect and he has begun to feel that scientific research and the labor-saving inventions which grow out of it are chiefly responsible for the hard times and unemployment and uneven distribution of property. Legislative bodies have been inclined to ask what after all science is up to, and to question whether the motives that activate it are as altruistic as the scientists in their arrogance would have us believe; they set about to curtail the funds that hitherto have been allotted to governmental research and grow inquisitive regarding the scientific attitude toward such things as the secrets underlying the manufacture of munitions.

This is surely a phenomenon of extraordinary interest. Not since the days when they were under close surveillance of the Church have scientists been put in a defensive position of this kind. But in this instance it is not the theologian but the man in the street and on the farm who is asking his neighbor "what price science?" And since the physical scientists in particular take themselves seriously and are prone to regard the results of their activities as benefactions to mankind, they have been struck all of a heap and a number of them have felt obliged to make a public apologia that has been none too convincing.

This surprising situation has been the more remarkable in view of the fact that scientific discoveries have never before been so widely heralded by an organized press agency, nor their applications so extensively advertised by exhibitions of scientific progress, like that recently held at Chicago, and by celebrations such as was staged three years ago on the centenary of the discovery of electro-magnetic induction.

Yet could modest Michael Faraday have stepped out of the Royal Institution where in the Christmas holidays of 1860 he had given to a juvenile audience six lectures on the chemical history of a candle, and have seen his familiar London in the dead of night ablaze with indirect lighting, he would, I imagine, have been somewhat taken aback by the responsibility laid at his door for all that the spectacle implied.

A good many people have been left confused, in the present discussion of the matter, as to the distinction between scientist and inventor—between what is called pure science—the disinterested search for truth —and the practical applications of scientific discovery through engineering. This is the more so because the apologists for science, in bolstering up their defence, have chiefly instanced some of the more outstanding scientific inventions and their relation to human comforts and conveniences. Even so, there may be reason to doubt whether the harvester, the internal combustion engine, the electric dynamo, the victrola, the cinema, the radio, the sawed-off machine gun and so on have in the long run been more beneficial or harmful. They enable us to do more in shorter time, to go faster between points, to banish darkness and so on, but how much human society has been benefited by more wheat with less labor, by getting somewhere a little quicker, by the products of Hollywood, the electric light and night life, the radio and its misleading advertisements, the machine gun and banditry, is open to question.

And whether any one thinks more clearly and deeply than before about the social problems that face humankind and whether people as a whole are as contented and happy as they were in simpler times may well be doubted. Invention of course is an inevitable part of science, in so far as the scientist continually has to improvise things to help with his researches, but the trouble comes when business takes both science and engineering into partnership and then through mass production abetted by the psychology of modern supersalesmanship makes the distribution of the economic benefits disturbingly lopsided.

Faraday's discovery was unquestionably the starting point of the electrical industry that has spread over the world and employs a vast number of people. At the same time, with the great expansion of electrical devices, the machine becomes man's chief competitor—the tractor-drawn harvester and gang-plow displace hordes of farm-hands; road-making and track-laying and concrete-mixing and electric-welding machines displace hordes of city laborers; the electric furnace and out goes the chore man, the frigidaire and away with the iceman, the dialling telephone dismisses an army of operators from the switchboard. Countless other illustrations might be given to show how the applications of a scientific discovery may well throw people out of jobs faster than the manufacture of its patented gadgets gives others employment.

A short time ago a distinguished British engineer in extolling what Einstein has called "the limitless perspective and beauty of modern science" referred to the newly completed Battersea Power Station as representing the highest stage of development of the science of engineering; for there three steam turbines with a total output of 300,000 horse-power—a power exceeding that of four and a half million laborers!—could be seen in the engine room all under the control of one man wearing a spotless white coat. While this may appear beautiful to the engineer, there is at the same time something inhuman and terrifying about it.

It is quite true that many patented inventions are purchased and closeted to protect industries that are temporarily stabilized. It is true also that one can not easily foresee what will be the ultimate effect on society of a given invention—like the invention of printing, for example, which in making a new trade threw a vast number of scribes and rubricators out of work. There was no possibility of heading off the reduplication of books even had it been desirable, any more than could the electric light, the telephone, the automobile, the cinema, the radio, the aeroplane and countless other inventions based on scientific experiment and discovery have been pushed aside.

None of them could we now do without. They indubitably have added vastly to the interest and zest of life and at the same time have played a large part in what we have mistakenly idolized as prosperity. It has been estimated, for example, in pointing out the beneficent rôle of applied science that the commercial value of the inventions of one man alone—the late Thomas Edison—have amounted to fifteen thousand million dollars. And just here it seems to

me that in some concealed way lies the crux of the matter. For compared with this vast sum, had Jenner's or Lister's or Pasteur's or Laveran's discoveries been patented and commercialized instead of being outright gifts to humankind, the economic value of any one of them would have been simply incalculable.

Theology, long the controlling factor in our educational system, finally was supplanted and the chief emphasis came to be laid on linguistic and literary culture. This state of things endured until the past century when the great advancement in the natural sciences and engineering enabled their representatives successfully to challenge the supremacy of the classics, thereby securing ultimate parity in the curriculum. At the present time we may be approaching another such change since in some institutions business has come to be accorded the dignity of a university subject. This would not be particularly disturbing were it not for the close association of business with engineering and other applied sciences through the commercialization of their inventions, this contact with its implication of advertising and salesmanship being as remote from the old humanism and its standards of culture as anything well could be.

The view has been expressed by Dr. Sarton that "Science must become more humanistic and that humanism must include science." But this is far from humanism ever coming to include business or from expecting business ever to become humanistic with its ancient maxim that "what's good for business must therefore be good for everybody," which is a little like saying that charity begins at home—and usually ends there. Dr. Sarton, I take it, was using the words in their more truly Ciceronian sense, as David Eugene Smith presumably does in saying[6] that by studying the mathematics of the Greeks in the original texts Regiomontanus was "the first who made humanism the handmaid of science."

So it may be horrifying to scholars to have what appears to be a modern connotation given to this historic word. Regiomontanus, however, was called from Nürnberg to Rome by Pope Sixtus IV to put his mathematical mind on the reform of the calendar and subsequently at his own expense printed the first almanac, a copy of which Columbus supposedly used on his voyages. This to my conception was no less humanistic on his part than taking up the study of Greek the better to understand the principles laid down by the early writers on mathematical and astronomical subjects.

It would be Utopian to expect of commercialized science that it should forego the financial returns from its discoveries and inventions on the grounds that if its activities are so definitely gifts to mankind, mankind should have a larger share in the profits. Yet this has been part and parcel of the ethical code of the doctor and of medical scientists from time immemorial—only to be broken occasionally of late years, I grieve to admit, under the provocation of economic necessity.

Time was when the doctor would have lost caste if he commercialized a secret remedy, the method of preparing a useful drug, a piece of apparatus or a surgical instrument. Now that the barrier has been broken and a university here and there has come to engage in the marketing of such products, there is danger that the tendency may spread and that the profession's long-accepted standards of humanism may come to be lowered. In the past, vast fortunes have been made for quacks and charlatans by the sale through advertising of worthless patent medicines, and the temptation must be great in these hard times for those who have discovered, let us say, some potent tissue extract that proves to be of a high medicinal value. Should it become a universal custom, however, and Medicine thereby become commercialized, she may well hang her head for her lost altruism, particularly should Science come to take a leaf from her book and decide that the greater part of the royalties on her patent rights justly belongs to the people. This has been done in a few instances but the practice is not likely to become universal for human nature is the last thing to change and this is still a practical, that is selfish, world and not the New Atlantis.

It is of course extremely doubtful whether Science is in any way to blame for the economic troubles in which the world has been wallowing. One might with equal reason lay unemployment and the increasing need of insurance against old age at the door of Medicine for keeping more people alive than can be employed. Nevertheless the fact that the question of responsibility has at this time been raised will certainly some day be looked back upon as a matter of great historical interst.

People in general are unquestionably becoming more socially minded—that is, more "humanistic" in its broader sense—and this is everywhere reflected in the governments that undertake, however feebly, to represent them. In a brilliant and courageous address[7] just a year ago before the American Association for the Advancement of Science, that modern Cato, the present Secretary of Agriculture, challenged the assembled scientists and engineers to tell where they were heading; and lest Spengler prove to be right in his pessimistic prophecies, he appealed to them to bend their talents to higher human aims than the mere increase of productive power.

In similar vein the Bishop of Carlisle opened the recent meeting of the British Association at Aberdeen

[6] "History of Mathematics," Vol. I, p. 260, 1923.

[7] Henry A. Wallace, SCIENCE, January 5, 1934.

with a sermon in which he asked whether the time had not come for science to abandon something of its severe spirit of isolation. The entire program of the meeting, indeed, was given over to a consideration of the social consequences of scientific discoveries. It represented a plea for the closer affiliation of science in the task of government "in terms which admit of unfettered inquiry, of undiminished loyalty to the truth, and a vision characteristic of the great age of Greece." This at least is what reports of the meeting said of it, and if that is not an appeal for a more humanistic science one is at a loss what to call it.

Among those who call themselves pure scientists, whatever their particular field, there are many who feel that they would demean themselves and lose caste among their fellows should they engage in researches that obviously point toward some utilitarian purpose. This I have always regarded as an academic pose; for in the disinterested pursuit of knowledge, to stumble, as did Röntgen or the Curies or Banting, on something not only of great scientific importance but which at the same time was immediately applicable to human welfare is certainly nothing to be ashamed of.

There have been plenty of socially minded and benevolent—dare I say humanistic?—scientists in the past. One quickly thinks of Benjamin Franklin, of Count Rumford and Humphry Davy, to give a few examples. Two of them were American-born, and to one of these the citizens of Munich erected a monument in gratitude for the reforms in public service and social economy that he had brought about while a resident in Bavaria. In their day was organized in England a Society for Improving the Condition and Adding to the Comforts of the Poor "by the systematic employment of scientific methods and knowledge."

Whether the present British Science Guild whose professed purpose is "to promote the application of the scientific methods to social problems and public affairs" is an outgrowth or a continuance of the older society I am not prepared to say, but the fact that no such organization exists in America should give our scientists pause. Never was there greater need for such a movement, and people are beginning to ask why our social problems are not being attacked by those presumably best fitted to solve them because of their familiarity with scientific methods.

Something of the sort might well enough grow out of the Science Advisory Board recently appointed to give advice and make recommendations to the government regarding ways in which science might be of service to the public interest. And should the leaders among our scientists grow more sensitive to the mood of the times and be persuaded at this juncture to focus their highly trained and inventive minds intensively on these difficult subjects, a more humanistic attitude of science or humanization of scientific effort might result which might check the present trend toward a machine-made and -operated civilization whose social dislocations more than offset the personal convenience of its many time-saving and labor-saving devices.

So let us hope that when some future student of this confused and disconcerting period in our history comes to tell of it, he will be able to say: That at the very time when such progress in their subjects was being made as never before, with one discovery following on the heels of another, the scientists and engineers of the country temporarily abandoned the investigations dear to their hearts in order to concentrate on problems the most difficult of all to solve—those that have to do with the social well-being of the community at large. Thus, under a quickly spreading Religion of Humanity, there began a new era—one in which scientists took a commanding position in a rapidly changing world and through their well-planned and executed experiments a new and rational science of society came into being and made its first great forward movement.

It has been said[8] that one distinct advantage we hold over our predecessors is that we have more history behind us; and that the value of classical studies is what they teach us, by example or warning, of the experiences of the civilizations from which we have sprung. So in all likelihood my imaginary historian in recording the new humanistic spirit that was born of the great depression will have occasion to add that those who played the most effective part in bringing it about, whether scientists or not, were persons who knew where were to be found the most noble examples of civic duty, who were familiar with the long history of another republic and who remembered Cicero's maxim, *Salus populi suprema lex esto.*

OBITUARY

DEATH OF THREE FORMER PRESIDENTS OF THE PHYSICS CLUB OF PHILADELPHIA

During recent months the Physics Club of Philadelphia has lost by death three of its former presidents.

Edward A. Partridge, president during 1912–13, died on March 22, 1934. He was educated at Central High School, Philadelphia, and at the University of Pennsylvania. In 1898 he was awarded the doctor's degree in mathematics. His life work was science

[8] J. W. Mackail's "Classical Studies," 1925, XII.

teaching in the Philadelphia schools. He was in charge of the department of science at West Philadelphia High School from 1912 to the day of his death.

He represents a vanishing type—the true scholar engaged in public secondary education. He collected a library of several thousand volumes on physics, philosophy, mathematics, astronomy and general literature. He read the important languages of Western Europe. He held memberships in many learned societies and was a constant reader of scientific journals. He was one of the first scholars in Philadelphia to sense the importance of the famous Einstein paper of 1916 and to discuss it in public.

In his pupils he assumed the existence of intelligence and intellectual curiosity. To these qualities he appealed. A record of more than forty years of inspiring teaching bears testimony to the genuineness of his educational philosophy.

Joseph M. Jameson, president during 1921–22, died on August 4, 1934. He was a native Pennsylvanian and was educated at Cornell University. He was in charge of physics at Pratt Institute for fifteen years, and from 1913 to his death was vice-president of Girard College. He was the author of "Elementary Practical Mechanics" and edited the Wiley Technical Series. He was active in scientific and educational societies. He wrote numerous articles on problems of science teaching. In recognition of his services to education Temple University awarded him the honorary degree of doctor of pedagogy in 1920.

In his teaching of physics, Dr. Jameson assumed in his pupils an interest in the machines, inventions and appliances of everyday life. He sought to convert this interest into a desire to comprehend the underlying sciences. This was his favorite method. It has numerous adherents in the educational world, and among them Dr. Jameson was recognized as one of its ablest spokesmen.

Edward J. Brady, president during 1925–26, lost his life at sea on the morning of September 8, 1934, in consequence of the burning of the steamship *Morro Castle.* He was educated at Cornell University. For many years he had been in charge of the Physical Laboratory of the United Gas Improvement Company.

He was the inventor of the Brady B.T.U. Indicator, a device used in gas plants throughout the world. For this invention he was awarded the Beal gold medal in 1919. He developed laboratory methods used in testing gas, oils and high temperature refractories.

The laboratory which he directed bears the stamp of his genial and wholesome personality. A member of his staff has said, "A year under his patient and able training was the equivalent of a graduate course in pure and applied physics." He was a member of many scientific and engineering societies. Among them the Physics Club ranked as a favorite hobby.

All three were men of sterling character and attractive personal traits, respected and admired by their associates. Through the death of these men this club has lost some of its most active members, and Philadelphia has lost three of its ablest men of science and three exemplary citizens.

DR. BERTRAM H. BUXTON

1852–1934

A UNIQUE figure passed from the ranks of British and American scientific investigators by the death of Dr. Bertram H. Buxton, which occurred at Devon, England, on December 5, 1934, at the age of 82 years. His life covered two full generations and witnessed the development of most of our modern science.

His work began in the early nineties, on board a cholera ship in New York Harbor, under Commissioner Doty. In 1902 he became pathologist to the Memorial Hospital, where he prepared Coley's toxins for the treatment of inoperable sarcoma. He then became director of the Huntington Fund for Cancer Research. In Cornell University Medical College he worked many years in the Loomis Laboratory, in bacteriology, biology and pathology. He was appointed instructor in bacteriology in 1898, associate professor of biology in 1903 and professor of experimental pathology in 1904. He returned to England in 1912. He made important contributions on the differential diagnosis of paratyphoid fever, on the bacteriology of typhoid fever, and on the physical chemistry of agglutination. He distrusted researches directed toward immediate practical ends. When a series of papers on "Absorption from the Peritoneal Cavity" seemed likely to have practical or commercial importance, he abandoned the field at once, went to Venezuela and produced a remarkable study of the invertebrate eye. He was a pioneer and expert in microphotography, and some of his early work has never been surpassed. His sole diversion was riding the bicycle and his remarkable skill in trick performances was long remembered by the pedestrians on the upper west side of Central Park.

Writing in the London *Times,* Dr. C. G. L. Wolf says: "His beautiful and original researches in the physical chemistry of agglutination laid a foundation of much of the very practical work now being done on the assay of toxins and antitoxins. The perfect charm, breadth of view, and superb technique are memories of Buxton which will not easily be forgotten by his many pupils and associates."

On returning to England he engaged in the study of plant physiology, especially the pigment functions and the production of hybrids. At the John Innes

Horticultural Institution he produced by mutation a giant fertile hybrid of foxglove which was recognized by the Kew authorities as a new species.

He was a pure scientific investigator, an artist in all things, and whatever he undertook he carried through outstandingly well. He was so modest and unassuming that his fine qualities were appreciated only by those closely associated with him.

JAMES EWING

RECENT DEATHS

DR. HERDMAN F. CLELAND, professor of geology at Williams College, was drowned when the steamship *Mohawk* sank on January 24. He was sixty-five years old.

DR. ALBERT MANN, since 1919 research associate in botany at the Carnegie Institution of Washington, died on February 1 at the age of eighty-one years.

DR. GRANVILLE MACGOWAN, formerly professor of surgery at the University of California, died on January 31 at the age of seventy-seven years. He was president of the American Urological Association in 1912.

FREDERICK S. DELLENBAUGH, anthropologist and explorer, died on January 29 at the age of eighty-one years.

MISS ROSALIE B. J. LULHAM, lecturer in natural history at the Froebel Educational Institute and author of "An Introduction to Zoology through Nature Study," died on December 28.

SCIENTIFIC EVENTS

THE PUBLIC HEALTH OF INDIA

THE report for 1931 of Major-General J. D. Graham, Public Health Commissioner with the Government of India, has recently been made public. According to the *British Medical Journal,* General Graham insists on India's need of an organization which shall be capable of framing and conducting a public health policy for the country as a whole. Such a Ministry of Health is found in Canada, Australia and South Africa, and is none the less necessary in India because the executive control of public health has been transferred to the Provinces.

A census was taken in February, 1931, and vital statistics for the year can be more accurately estimated than in the nine previous years, the last census having been taken in 1921. The birth rate for the year in British India was 34.3 per mille, as compared with 33.4 on the estimated population for 1930, and 35.7 for the previous quinquennium (based on the 1921 census). The general death rate was 24.8 per mille, and the death rate for infants under the age of 12 months per 1,000 live births was 178.8, as compared with 180.8 in 1930 and 177.6 in the previous quinquennium. Out of every 190 deaths recorded, forty-three occurred in children below the age of 5, and forty-eight in those below the age of 10. The infantile death rate for British India was nearly 2⅔ times that for England and Wales and South Africa; more than double that for Germany, and nearly 5½ times that for New Zealand. Countries in which the figures compare more closely with those of British India include Rumania, Hungary, Japan, Italy, Egypt and Soviet Russia. The three main causes of infantile mortality are given as congenital and developmental defects, alimentary disturbances and infective disease, the first accounting for nearly all stillbirths and deaths in the first seven days of life, while the two latter affect the older children. Sanitary improvements have operated against the two latter causes, but not against the first, and in the production of these defects prematurity plays an important part.

Antimalarial campaigns continued during the year under review, including cinchonization schemes where funds permitted. Tuberculosis is believed to be generally on the increase, especially in some of the larger and more overcrowded cities, such as Peshawar, Delhi and Calcutta. The anti-tuberculosis campaign has not proceeded very far as yet, but the disease is now notifiable in the Punjab, the Central Provinces, Madras, Baluchistan and in municipal areas in Assam and the Upper Provinces. In Bombay Presidency, out of every 1,000 deaths recorded in 1931, 43.6 were ascribed to pulmonary tuberculosis. In 1931 there was a large fall in the incidence of cholera in British India, apart from the Presidency of Bombay, but high mortality curves were present in Bengal and Bombay. The death rate for plague was, however, twice that in 1930, although lower than that in 1929, the Upper Provinces suffering most.

Leprosy surveys, which had been continued during three and a half years, were ended in 1931. They showed that leprosy was much more prevalent in India than was formerly supposed; probably one million cases would not be an overestimate. The disease was found to be most common among semi-aboriginals or aboriginals, who left their tribal seclusion and hired themselves out to agriculturists or industrial concerns. Infection of the more advanced classes of the community was in the first place largely attributable to the employment of servants in an infectious stage. Movements of the population, which have increased

on account of better education and transport in recent years, are a potent factor in spreading the disease and in infecting new areas. This is General Graham's last annual report as Public Health Commissioner and he briefly reviews his decennium in that office and indicates the more salient advances.

THE FIELD MUSEUM ANTHROPOLOGICAL EXPEDITION TO THE NEAR EAST

THE Field Museum Anthropological Expedition to the Near East, sponsored by Marshall Field, has concluded its work for 1934, consisting of an anthropometric survey of the native population of Iraq, and similar studies in Persia and the Caucasus region of the U.S.S.R.

The leader of the expedition, Henry Field, assistant curator of physical anthropology, has returned to his post in the museum, ready to begin the task of assembling and studying the data collected, which has for its purpose an attempt to solve certain racial problems. One of the objectives is to determine the relationship of the peoples of the Near East, both those of to-day and their ancient ancestors, to the modern and ancient peoples of Africa, Europe and Asia. This is a question of great scientific importance into which no satisfactory research has previously been made.

The work of the expedition covered a period of ten months, during which 17,000 miles were traveled, and 3,000 persons were submitted to studies, consisting of anthropometric measurements and observations, the taking of front and profile photographs, hair samples, blood samples, and other data pertinent to tracing racial origins. In addition to its anthropological work, the expedition collected 3,000 animals, 1,000 insects, 2,600 plants and a quantity of geological material, for the departments of zoology, botany and geology.

Mr. Field was accompanied by Richard A. Martin, of Chicago, who as photographer made 7,000 negatives, and in addition collected the zoological material, as well as assisting the leader in the anthropological work. As many as twelve assistants were attached to the expedition temporarily at various points for local work. The anthropological studies were a continuation of the survey begun by Mr. Field in 1925.

Observations were made upon selected subjects from each of the important racial groups. Of special interest in Iraq were the Kurds, fierce-looking mountain tribesmen, of whom 750 submitted to the anthropologists' calipers and cameras, and the Yezidis, fanatical devil-worshipers, 300 of whom cooperated by acting as scientific specimens. Forty separate measurements and observations were made on each individual. Living in tents as guests of Sheikh Agil, great desert chieftain of the Shammar Beduins, the members of the expedition were enabled to measure 450 members of this tribe.

The expedition made an archeological survey of the North Arabian Desert, crossing from Baghdad to Trans-Jordan Palestine and Syria, and thence returning to Iraq. During this trip a large number of prehistoric flint implements testifying to the existence of early man in this area were collected.

After five months in these areas, the expedition proceeded to Persia, where anthropological studies were made of some 250 individuals. After completing its work in that country, the expedition entered the U.S.S.R. at Baku, and traveled through the Caucasus to Kiev, Moscow and Leningrad. In the mountains of the Caucasus some 200 men and women were studied.

PENNSYLVANIA'S PRIMEVAL FOREST

EDWARD E. WILDMAN, member of the "Tionesta Committee" of the Pennsylvania Forestry Association, writes that on Friday, November 23, 1934, the National Forest Conservation Commission approved the purchase by the United States Forest Service of 4,000 acres of primeval forest still standing in Warren and McKean Counties, Pennsylvania, in the northwest section of the state, and within the limits of the Allegheny National Forest Reservation. It is known as the Tionesta Tract.

The stand is mainly a hemlock-mixed hardwood type, with fine old trees here and there of black cherry and cucumber. The Pennsylvania Forestry Association has been urging the preservation of this tract for the past three years as a forest laboratory where only observation, not experimentation, should be carried on. It is with this understanding that the commission authorized its purchase. Trails will be made into the forest where they can be laid without cutting, but no camping there is contemplated.

Under the title "The Thousandth Acre," the tract was described by the Allegheny Forest Research director, R. D. Forbes, recently in *American Forests.*

The Forest Service wants to see how this forest maintains itself and its wild life century after century totally undisturbed by man. Its fauna and flora are typical of the Middle Atlantic States, and therefore this tract is unique, for those of the nearest primeval regions now preserved—the Adirondacks on the north and the Great Smokies on the south—are different in many features. Mr. Wildman writes:

> Not only professional foresters, but every student of natural history and every lover of the untouched wilderness will be glad to hear of the success of the association in this endeavor.

Historically, its preservation is most fitting, for this tract is part of the actual forest that gave the name Pennsylvania to the province when it was granted to William Penn in 1681. Indeed, the association began its work for the preservation of this tract as its part of the program of celebration in 1932 of the 250th anniversary of the coming of William Penn to his province. Philadelphia and other cities along the Delaware celebrated that event in various beautiful and appropriate ways, but for lovers of the out-of-doors, and Penn himself was one, the preservation of this large tract of Penn's own woods will be counted perhaps first in such a memorial program.

GRANTS OF THE ELLA SACHS PLOTZ FOUNDATION

DURING the eleventh year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, eighty-three applications for grants were received by the trustees, forty of which came from the United States, the other forty-three from thirteen different countries in Europe, Asia and Africa. The total number of grants made during 1934 was twenty-seven, one of these being a continued annual grant. Fourteen of the new grants were made to those working in science outside of the United States.

In the eleven years of its existence, the foundation has made two hundred and twenty-seven grants, and investigators have been aided in Argentina, Austria, Belgium, Chile, China, Czechoslovakia, Esthonia, France, Germany, Great Britain, Hungary, Italy, Jugoslavia, Latvia, Netherlands, Palestine, Poland, Portugal, Roumania, South Africa, Sweden, Switzerland, Syria and the United States.

The list of investigators and the purpose of their researches aided during 1934 is as follows:

Dr. Z. M. Bacq and Dr. M. Florkin, Liége, Belgium, study of the action of various drugs, in relation to the autonomic nervous system, and to the potassium content of the blood serum; Dr. S. J. Crowe, Johns Hopkins Hospital, continuation of experiments on the physiology of the ear; Professor Ludwig Braun, Vienna, Austria, continuation of studies of heart disease; Dr. Douglas R. Drury, University of Southern California Medical School, investigation of experimental renal insufficiency; Dr. Hans Dworzak and Dr. Kurt Podleschka, Prague, Czechoslovakia, study of the growth of ovaries transplanted into the eyes of rabbits as influenced by different hormones; Professor Dr. Philipp Ellinger, London, England, continuation of work on the physiology, pathology and pharmacology of the kidney, and research on microscopical observations of the beginnings of cancer by method of intravital staining; Dr. Giovanni Favilli, Florence, Italy, work on Brucella polysaccharides; Professor René Gayet, Paris, continuation of researches on the output of blood from various organs; Dr. Arthur Grollman, Johns Hopkins University Medical School, continuation of chemical studies on the nature of the adrenal cortical hormone and an investigation of its physiological interrelationships in the organism; Dr. Ellis H. Hudson, Deir-ez-Zor, Syria, investigation of the Arab type of childhood syphilis; Dr. H. D. Kay, Berks, England, investigation concerning the relationship of phosphorus deficiency to rickets; Dr. Edgar Lederer, Paris, continuation of work on carotinoids and vitamins; Dr. David Marine, Montefiore Hospital, further study of experimental exophthalmos and thyroid hyperplasia together with the effect of the antigoitrous agent (ascorbic acid) on these conditions; Dr. Ernst Mueller, Presbyterian Hospital, New York City, capillary pressure estimations; Dr. John P. Peters, Yale University School of Medicine, certain studies of water and salt metabolism, with special reference to nephritis; Dr. Hermann Pinkus, University of Michigan Medical School, investigations with cultures of human tissues, particularly in connection with cancer work; Dr. Eugene Pollak, Vienna, Austria, study of lipoid catabolism in the central nervous system; Professor Hans Pringsheim, Paris, researches in the chemistry and biochemistry of polysaccharides; Dr. Samuel H. Proger, Boston Dispensary, continuation of work on the effect on patients with heart disease of lowering the level of energy metabolism by means of prolonged dietary restriction; Dr. Jane Sands Robb, Syracuse University Medical School, study of the conduction paths in the mammalian ventricles; Professor Rothberger, Vienna, Austria, electrocardiographic research; Thorndike Memorial Laboratory, Boston City Hospital (Professor George R. Minot, director), continued since 1927 in recognition of Dr. Francis W. Peabody's services to the foundation; Professor Waldschmidt-Leitz, Prague, Czechoslovakia, study of the ferments in cancer; Dr. Carl J. Wiggers, Western Reserve University, continuation of work on the dynamics of the coronary circulation; Dr. William F. Windle, Northwestern University, study of the development of behavior in the embryo correlated with the development of intrinsic structure in the nervous system; Dr. M. M. Wintrobe, Johns Hopkins Hospital, studies of the morphological changes in red blood corpuscles in animals; Professor René Wurmser, Paris, continuation of studies of oxidation reduction phenomena in cells.

The maximum size of grants will usually be less than $500. Applications for grants to be held during the year 1935–1936 must be in the hands of the executive committee before May 1. There are no formal application blanks, but letters asking for aid must state definitely the qualifications of the investigator, the character of the proposed research, the size of grant requested and the specific use of the money to be expended. Only applications complying with the above conditions will be considered. It is also highly desirable to include letters of recommendation from the directors of laboratories or clinics in which the work is to be done.

THE ANNUAL MEETING OF THE SMITHSONIAN INSTITUTION

NOTABLE scientific advances in the face of seriously curtailed income were reported to the Board of Re-

gents of the Smithsonian Institution, at their annual meeting on January 17. Dr. Charles G. Abbot, the secretary, reports that while it has been necessary to curtail seriously research, explorations and publications, the year has been exceptionally fruitful. Very significant progress is believed to have been made in the study of the dependence of weather upon variations in the sun's heat and also much accurate data have resulted in the Division of Radiation and Organisms. Notable archeological progress was made by CWA projects in charge of members of the institution's staff. Otherwise field work was reduced to a minimum, owing to lack of funds.

Dr. Abbot announced one bequest, amounting to more than $58,000, from William Herbert Rollins, of Boston, to establish a fund "for exploration beyond the boundary of knowledge." New specimens to the number of 340,780 were added to the collections of the National Museum. These included valuable anthropological materials from Africa, Honduras, Nicaragua, Australia, Alaska and various regions of the United States; large collections of mammals, birds and other forms of life from China and Siam; unusually large collections of insects, one alone numbering 69,000 specimens; and many important plant specimens from North and South America, Hawaii, Poland and French Indo-Chino.

Among the large number of rocks, gems, meteorites and fossils obtained, special mention was given by Dr. Abbot to the collection of 25,000 rocks assembled by the late Dr. Henry S. Washington, one of the world's leading petrologists, and to the Tellef Dahll collection of minerals from Norway. An important addition to the Arts and Industries collection was the airplane in which Galbraith P. Rodgers completed the first flight across the United States in 1911. To the historical collections Mrs. Herbert Hoover added a costume worn by her at the White House.

The collections of the Freer Gallery of Art were increased during the year by specimens of Arabic bookbinding, Chinese bronzes, Chinese and Persian ceramics, Arabic glass, Chinese gold work, an Armenian manuscript, and Chinese, Byzantine, Indian and Persian paintings. The need was stressed for more adequate buildings for the National Zoological Park, with more than 2,000 valuable animals.

Work has continued during the year, he reported, on intensive study of the biological specimens obtained by the Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep last year, and fifteen papers describing new forms have been published. The year marked the conclusion of the research of Dr. C. U. Clark in European archives for material concerning the early history and exploration of America. Some very valuable manuscripts were brought to light, which would be published if funds were available.

Chief Justice Charles Evans Hughes, chancellor of the Smithsonian Institution, presided at the annual meeting of the regents. The board is composed of the following members: Vice-president Garner; Senators Joseph T. Robinson and M. M. Logan; Representatives T. Alan Goldsborough and Charles L. Gifford, and Irwin B. Laughlin, Frederic A. Delano, John C. Merriam, R. Walton Moore, Robert W. Bingham and Augustus P. Loring.

SCIENTIFIC NOTES AND NEWS

THE council of the British Institution of Electrical Engineers have awarded the Faraday Medal to Dr. Frank B. Jewett, president of the Bell Telephone Laboratories and vice-president of the American Telephone and Telegraph Company.

THE two gold medals of the American Institute, established more than a century ago, have been awarded this year to the Rev. Julius A. Nieuwland, Notre Dame University, and to Dr. Carl D. Anderson, the California Institute of Technology, it has been announced. Presentation of the medals took place at the annual dinner of the American Institute at the Hotel Astor on February 7. The award to Father Nieuwland is for his discovery of a process for making synthetic rubber. Dr. Anderson is honored for his discovery of the positron, of the positive electron, a new fundamental unit of matter, having the mass as the electron but carrying a positive unit of electric charge.

THE 1935 gold medal of the Royal Astronomical Society of London has been awarded to Professor E. A. Milne, Rouse Ball professor of mathematics at Oxford University, "for his work on radiative equilibrium and theory of stellar atmospheres." The gold medals for the previous two years were awarded to Professor V. M. Slipher, of the Lowell Observatory, in 1933, and Dr. Harlow Shapley, of the Harvard College Observatory, in 1934.

PROFESSOR HAROLD C. UREY, discoverer of heavy water and winner of the Nobel Prize in chemistry for 1934, was honored at a farewell dinner on the night of February 1 by the Chemists' Club in New York City. Professor Urey, accompanied by Mrs. Urey, sailed on February 2 on the *S. S. Gripsholm* for Sweden, where he will deliver the Nobel address before the Swedish Royal Academy of Science on February 14. About 125 metropolitan chemists, including the board of trustees of the Chemists' Club, attended the dinner. Professor Victor K. LaMer, of Columbia University, de-

livered the principal address, reviewing Professor Urey's work with the heavy isotope of hydrogen. Dr. George Murphy, of Columbia University, and Dr. F. G. Brickwedde, of the Cryogenic Laboratory of the U. S. Bureau of Standards, who assisted Professor Urey in his experimental work, were guests of honor and spoke briefly. Professor Marston T. Bogert, of Columbia University, was the toastmaster.

A TESTIMONIAL dinner was given to Dr. George Hoyt Whipple, professor of pathology and dean at the University of Rochester School of Medicine, on January 15 in recognition of his work on anemia. Dr. Whipple was one of the three recipients of the Nobel Prize in physiology and medicine in 1934.

DR. CLARENCE H. KENNEDY, professor of zoology and entomology at the Ohio State University, has been elected president of the Entomological Society of America.

OFFICERS of the Pathological Society of Philadelphia have been elected as follows: *President,* Dr. Morton McCutcheon; *Vice-president,* Dr. Esmond R. Long; *Secretary-Treasurer,* Dr. Herbert L. Ratcliffe.

SIX members of the faculty at the University of North Carolina have been promoted to the rank of Kenan professors. They are: Dr. Edgar W. Knight, professor of education; Dr. John F. Dashiell, head of the department of psychology; Dr. William M. Dey, head of the department of romance languages; Dr. Gustave A. Harrer, professor in the department of Latin; George Coffin Taylor, professor in the department of engineering, and Erich W. Zimmerman, professor in the department of economics. The appointments are made possible by the Kenan Professorship Endowment, a fund which was bequeathed to the university in 1916 by the will of the late Mary Lilly Kenan Bingham.

DR. LINUS WARD KLINE, director of the department of psychology, and Mrs. Frances Littleton Kline, associate professor of chemistry, have resigned from the faculty of Skidmore College. Dr. Carl E. Smith, assistant in the department of psychology at Harvard, has been appointed to succeed Dr. Kline in September.

THE following are changes in the staff of the school of chemistry and physics at the Pennsylvania State College: Dr. J. H. Simons, secretary of Section C of the American Association for the Advancement of Science, has been appointed associate professor of physical chemistry. Dr. F. L. Carnahan will replace W. B. McCluer in charge of the Petroleum Refining Laboratory supported by the Pennsylvania Grade Crude Oil Association as part of Dr. Fenske's petroleum refining research unit. Mr. McCluer has joined the technical staff of the Kendall Refining Company.

THE Buffalo Museum of Science has appointed Dr. A. E. Alexander as research associate in mineralogy and petrography. Dr. Alexander was formerly petrographer with the Spencer Lens Company.

PROFESSOR MARTIN MEYER, of Brooklyn College, has been appointed acting head of the department of chemistry, in place of Professor Frederick E. Breithut, who has been assigned to special work in connection with the construction of the proposed new Brooklyn College buildings.

DR. EDWIN MATTHEW, honorary physician at the Edinburgh Royal Infirmary and Leith Hospital, has been appointed to the chair of clinical medicine at the University of Edinburgh. He succeeds Professor Edwin Bramwell, who resigned on January 1.

PROFESSOR JUVENAL VALERIO RODRÍGUEZ has been appointed director of the National Museum of Costa Rica. Professor Rodríguez is a botanist who has devoted much time to study of the Costa Rican flora.

PROFESSOR AUSTIN M. PATTERSON, head of the department of chemistry and vice-president of Antioch College, has been appointed to the newly constituted international committee on organic chemical nomenclature of the International Union of Chemistry. The other members of the committee are: Mario Betti, Bologna; R. Marquis, Paris; Friedrich Richter, Berlin, and P. E. Verkade, Rotterdam.

PROFESSOR W. R. LONGLEY, of Yale University, was nominated as representative of the Mathematical Association of America on the National Research Council for a three-year term from July 1, 1935, in succession to Professor H. L. Rietz.

DR. HERBERT S. JENNINGS, Henry Walters professor of zoology and director of laboratories at the Johns Hopkins University, spoke on "What is the Rôle of Mutations in Evolution?" at the meeting of the American Philosophical Society on February 1 in Philadelphia.

DR. ABRAHAM FLEXNER, director of the Institute for Advanced Study, Princeton University, and Dr. Morgan Ward, also of Princeton University, will be guest speakers at The Mathematics Chairmen's Association at its annual open luncheon meeting on February 16, at the Hotel Astor in New York at 10 o'clock.

PROFESSOR WM. SEIFRIZ, of the University of Pennsylvania, lectured on January 26 before the Botanical Seminar of the Johns Hopkins University on "The Forests of the Western Caucasus and Mt. Elbruz."

AT the 103rd annual general meeting of the Harveian Society of London, held on January 10, Dr. A. Hope Gosse delivered the presidential address on "The Diagnosis of Diseases of the Chest by Means of

X-rays." Dr. Gosse then inducted his successor, L. E. C. Norbury, in the presidential chair. The following officers were elected for the ensuing year: *Vice-presidents,* Dr. G. Macdonald Critchley, Professor Tom Hare, Dr. N. Gray Hill, Professor C. A. Pannett; *Hon. treasurer,* Cecil P. G. Wakeley; *Hon. secretaries,* Dr. A. D. Morris and John Hunter; *Council,* Dr. D. H. Brinton, Dr. F. S. Cooksey, Dr. A. Hope Gosse, Dr. Norman Hill, Dr. F. Hobday, Dr. T. C. Hunt, Dr. A. F. Morcom, Dr. A. D. Munro, W. E. Tanner, Dr. G. de Bec Turtle, Dr. R. R. Watts and A. Dickson-Wright.

DR. ELLIOTT C. CUTLER, Moseley professor of surgery at Harvard University Medical School, will give the second lecture in the annual Judd Lectureship in surgery on the evening of Tuesday, February 19, in the auditorium of the chemistry building at the University of Minnesota. The subject of Dr. Cutler's lecture will be "Total Thyroidectomy for Heart Disease."

A LECTURE series, made possible by the Kellogg Foundation, will be given at Rutgers University beginning on February 27. The first lecture will be given by Dr. William Beebe, curator and director of the department of tropical research of the New York Zoological Society. Subsequent lectures on March 27 and April 17 will be given, respectively, by Donald R. Richberg, executive director of the United States Emergency Council, and Dr. Robert A. Millikan, of the California Institute of Technology.

SIR FREDERICK GOWLAND HOPKINS, president of the Royal Society, delivered the Sir Henry Trueman Wood Memorial Lecture on "The Study of Human Nutrition; the Outlook To-day," at the Royal Society of Arts in London on February 5.

SIR WILLIAM BRAGG, Fullerian professor of chemistry at the Royal Institution and director of the Davy-Faraday research laboratory, lectured before the Royal Institution on January 18 on "The Theoretical Strength and Practical Weakness of Materials."

AN Association of Southern California Botanists was organized at a meeting held on November 3, 1934, at the University of California at Los Angeles, Professor G. J. Peirce, professor of botany at Stanford University, presiding. The group is to include teachers in high schools, junior colleges, colleges and universities, members of experiment stations and research laboratories, state and federal services, and individuals interested in botanical subjects. The activities of the organization will be arranged by a governing board. The board members chosen on November 3 are: Dr. O. L. Sponsler, professor of botany at the University of California at Los Angeles; Dr. Howard de Forest, head of the department of botany at the University of Southern California; Dr. E. M. Harvey, plant physiologist, bureau of plant industry, U. S. Department of Agriculture; Dr. James V. Harvey, professor of botany, San Bernardino Junior College; Dr. Robert Emerson, assistant professor of biophysics, California Institute of Technology.

A MEETING of the New England section of the American Physical Society was held at the George Eastman laboratory of the Massachusetts Institute of Technology on February 2.

THE second annual convention of Maryland Teachers of Biology will be held on April 13, at the Maryland Academy of Sciences building, Baltimore, beginning at 10 o'clock, A. M. There will be a morning, an afternoon and an evening session, with a dinner at 6:15.

A NEW quarterly publication entitled *Farm Research* will be issued by the New York State Agricultural Experiment Station at Geneva. The chief aim of the new publication is to present the results of the research work of the station to the farmers of the state by means of brief popular articles prepared by members of the research staff.

THE Field Museum of Natural History has come into possession of an addition to its library of some 5,000 volumes, including much material of extreme rarity and value, left to it by the late Dr. Berthold Laufer, curator of the department of anthropology, who died in September, 1934. Simultaneously the American Friends of China, Chicago, as a memorial to Dr. Laufer, made a gift of $500 to the museum to be used for expenses in connection with the cataloguing and arrangement of the Laufer Library in a manner that will increase its usefulness.

A GRANT of $1,000 has been made by the National Research Council to the department of chemical engineering of the Massachusetts Institute of Technology for research on gel structures in cement. The work will be under the direction of Dr. L. S. Brown.

INCOME from the $450,000 Bowman bequest will, for the time being, be used by the University of Wisconsin to establish a series of special cancer research fellowships. The board voted also to continue the special committee which it set up several months ago to decide in what ways the income from the fund could be put to the best use in cancer research work. Those on the committee are President Glenn Frank, Dean Charles R. Bardeen, of the medical school, and Dean E. B. Fred, of the graduate school. Establishment of the series of special cancer research fellowships is expected to permit the university to push forward its efforts to determine the causes and cure of cancer. The fellowships will bring to the university those who are specializing in that field of medical research, and

will add impetus to the work which is already being carried on by other institutions. Income from the Bowman fund, which was left to the university in the will of the late Jennie Bowman, Wisconsin Dells, who died early in 1934, will amount to about $12,000 yearly at present, but is expected to become larger in future years.

THE American-Scandinavian Foundation will this year award a special fellowship of $1,000 for research in electrical engineering in Sweden. This fellowship is named for Irving Langmuir, winner of the Nobel Prize in 1932, and the recipient will be expected to visit Dr. Langmuir and his associates at the General Electric Company before leaving for Sweden. We learn from the *Journal of Industrial and Engineering Chemistry* that in April the foundation will award to students of American birth a number of traveling fellowships for study in various fields of science in the Scandinavian countries during the academic year 1935–36. The fellowships will carry stipends of $1,000 each. Graduate students and younger instructors and professors are especially invited to become candidates. Wherever possible the papers of all applicants from one institution should be considered first by a committee of professors in that institution and forwarded to the jury with an indication of preference. Application papers, including letters of recommendation and photograph, must be filed at the office of the foundation before March 15, 1935. The jury which makes the final selection is composed of college professors and technical experts and has as chairman Professor William Hovgaard, of the Massachusetts Institute of Technology.

THE Committee on Scientific Research of the American Medical Association has made a grant to Professor Edward S. West, of the University of Oregon Medical School, for studies on hydroxylated fatty acids.

UNDER the national fellowship plan of the chemistry department of the Johns Hopkins University four fellowships for graduate study in chemistry are open to qualified students in colleges and universities. The four are the American Can Company Fellowship for California, the Mary Carroll Garvan Fellowship for Connecticut, the G. A. Pfeiffer Fellowship for Iowa and the Chemical Foundation Fellowship for the states of Arizona, Idaho, Nevada, New Mexico, South Dakota and Wyoming. The purpose of the National Fellowship Plan is described as "the selection and training of chemists who are especially fitted to contribute to fundamental chemical research." The fellowships are held for a period of four years, contingent upon the satisfactory progress of the student. They give the recipients an opportunity for basic training and original research in chemistry and related subjects. In addition to the essential curriculum, the students are given an opportunity for personal contact with leading European and American chemists, through a visiting lectureship which has been provided by Dr. A. R. L. Dohme, of Baltimore. The selection of the successful candidate is accomplished through state committees which evaluate the student's complete previous scholastic record and his personal qualities as rated by his instructors. Students in the sophomore, junior and senior year of the colleges and universities of the designated state are eligible for the fellowships, or students anywhere in the United States provided they hold their residence in one of the respective states. The successful candidates will be notified on or before April 15, and will begin their work at the Johns Hopkins University in October. Applications should be made to Professor Neil E. Gordon, the Johns Hopkins University, by February 15.

THE fifth annual series of free public health lectures presented jointly by the Cleveland Academy of Medicine and the Albert Fairchild Holden Foundation will begin on January 13 with an address by Dr. Gerald S. Shibley, associate professor of medicine, Western Reserve University School of Medicine, on "The Common Cold." Succeeding lectures will be given by Drs. Russell L. Haden, on "Anemias and Diet"; Marion A. Blankenhorn, "The Art and Science of Diagnosis," and John A. Toomey, "Stopping the Spread of Contagions."

A SERIES of twelve public lectures on medical subjects will be given by members of the teaching staff of Harvard University at the Medical School on successive Sunday afternoons. The series began on January 6 and will end on March 26. The lecturers and their subjects are: Dr. R. G. Hoskins, research associate in physiology, "Gland Factors in Personality"; Dr. H. B. Sprague, assistant in medicine, "What Causes Heart Disease?"; Dr. Alice Hamilton, assistant professor of industrial medicine, "Dangerous Trades"; Dr. J. O. Pinkston, teaching fellow in physiology, "The Body Temperature"; Dr. H. D. Chadwick, lecturer on public health administration, "Tuberculosis as a Children's Disease"; Dr. H. C. Trimble, assistant professor of biological chemistry, "Minerals in our Bodies and our Foods"; Dr. H. F. Root, assistant in medicine, "Diabetes"; Dr. D. B. Dill, assistant professor of biological chemistry, "External Influences on Physical Activity"; Dr. E. C. Cutler, Moseley professor of surgery, "Cancer"; Dr. G. H. Parker, professor of zoology and director of the Zoological Laboratory, "Twins and Social Biology"; Dr. C. B. Vaughan, assistant professor of clinical dentistry, "Facts regarding the Control of Diseases of the Gums"; Dr. F. C. Irving, professor of obstetrics, "Inheritance."

DISCUSSION

A WIDE-SPREAD ERROR RELATING TO EGYPTIAN MATHEMATICS

IN a recent book entitled "Vorlesungen über Geschichte der Antiken Mathematischen Wissenschaften" (Vol. 1, p. 122, 1934), its author, O. Neugebauer, directs attention to a popular mathematical legend which seems to have been started by the late Moritz Cantor (1829–1920) who has sometimes been called the prince of mathematical historians. According to this legend, the ancient Egyptians constructed right angles by means of a cord with three knots separated by distances in the proportion of 3, 4, 5. This legend appears, among many other places, in the most commonly used American textbooks on the general history of mathematics as well as in those of various other countries, but it is not supported by the mathematical writings of the ancient Egyptians which have been deciphered up to the present time.

It seems to have been due originally to a misinterpretation, but the high standing of the work in which it first appeared and its elementary character naturally led to its wide adoption by other writers. Since right angles can be constructed in the given manner it is obviously impossible to prove now that the ancient Egyptians did not use this method for this purpose, but the definite statement that they used it naturally implies that it appears in their deciphered writings and this is incorrect. These writings contain sets each composed of three numbers which are in the proportion of 3, 4, 5 and were known at least as early as 2000 B.C. to satisfy the condition that the sum of the squares of the two smaller ones is equal to the square of the largest, but such examples of numerical relations are far removed from proving that the ancient Egyptians were familiar with the corresponding geometrical properties. The deciphered writings exhibit no definite evidence to the effect that they recognized the correspondence between these arithmetical and geometrical relations.

The crowning mathematical achievement of the ancient Egyptians is the so-called formula for the volume of the frustum of a square pyramid. In a strict sense of the term neither the pre-Grecian mathematicians nor the ancient Greeks themselves developed a mathematical formula. The pre-Grecian mathematicians had neither rules nor formulas but gave merely numerical examples which correspond to formulas. The ancient Greeks had rules but no formulas, since the mathematical language was not then sufficiently developed to express results in modern formulas. This could not be done until the people of western Europe had created the needed mathematical language at about the close of the middle ages. Such questions belong to explicit mathematical history and hence they are not controversial. It is only the implicit mathematical history that has given rise to controversies.

G. A. MILLER

UNIVERSITY OF ILLINOIS

ONE ASPECT OF THE LONGEVITY PROBLEM

PRELIMINARY experiments on the giving of dilute sodium rhodanate solutions continuously to rabbits and chickens instead of water were reported at the Cleveland meeting of the National Academy of Sciences, November 20, 1934. The work was financed in part by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University. These preliminary results indicate that sodium rhodanate improves the general health and lessens the nervous irritability of rabbits and chickens, thereby increasing their resistance to coccidiosis, respiratory infections and infectious leukemia. There is reason to believe that a number of other diseases should not be so acute and fatal in animals treated with sodium rhodanate. Of even more interest to us are the general conclusions which we believe that we are justified in drawing from these experiments and from our preceding work, a great deal of which is still unpublished.

In the last twenty-five years the probable length of human life has increased materially, thanks to medical science; but the change has been due very largely to a decrease in mortality among infants and children. The probable length of life of a man of forty-five has not been increased appreciably in the last quarter-century. Medical science has failed so far as such men are concerned.

The colloid chemist comes in where the medical man drops out. Sodium rhodanate and drugs of that type will minimize the physical effects of worry and will decrease the tendency to nervous breakdowns not caused by definite pathological conditions. Sodium rhodanate increases the resistance of the living organism to infection by inducing better health. Drugs of this type will not cure progressive lesions and sclerotic conditions; but they will retard the aging of the colloids of the body and will thereby delay the onset of such pathological conditions. If every human being of forty-five or over, for whom sodium rhodanate is not contra-indicated, would take sodium rhodanate regularly for the rest of his life, we predict an average increase in the probable length of life of at least two years, provided the medical men will cooperate.

We can not prove this prolongation of life now because every application to a foundation for money for research is referred, inevitably and properly, at some stage to a medical man and turned down by

him, inevitably and improperly, on the ostensible ground that the matter is not yet proved and therefore should not be supported. If it had been proved, we should have been asking for money for some other purpose.

A few medical men have been interested in our point of view. We thank them for this and we hope that we may retain their sympathy in the stormy days that are to come.

The medical profession, as a whole, is hostile to us, due to the attitude of those who should be the leaders. So far as we know, not a single medical school or hospital has shown any active, intelligent interest in our work. Two deans of medical schools have been good enough to make clear to us what the attitude of the medical profession is. We have confirmed the following views independently:

(1) Nothing good along lines of research involving living tissue can come from chemists.

(2) Our line of reasoning is foreign to the medical mind and the authorities in the medical profession consequently consider our work and conclusions so unsound that it would be a waste of time to check either.

(3) Since our experimental work is bad by hypothesis, one hundred or even five hundred cases would not be convincing, because one hundred or five hundred experiments done badly have no cumulative value.

(4) Since our conclusions are unsound by definition, any doctor confirming our findings proves thereby that he is incompetent to do that type of research.

At Beaufort, N. C., Miss Koehring has shown that treating a starfish with ether or chloroform causes a reversible agglomeration of some of the proteins in the walls of the stomach. Though this experiment can presumably be confirmed by anybody who is interested, the experimental results carry no weight in medical science against an *obiter dictum*. The theory of Claude Bernard on anesthesia is to be considered wrong; not because it is wrong but because we have shown it to be a first-class working hypothesis.

Pauli's work along similar lines to ours has stood uncriticized for about thirty years, but is now automatically and officially worthless because it confirms our results.

Our answer to the medical profession is simple. It is up to them to clean house. From now on it is a fight to the finish between the medical profession and ourselves. There can be only one outcome to this contest. The medical profession will lose. The medical profession—or their unwise leaders—can and probably will retard progress; but they can not prevent progress completely.

We challenge the medical profession to run fair tests of our treatment, with all experimental details released, on certain forms of alcoholism, insomnia and sciatica. These are selected because even a medical man should get good results the first time. The medical profession does not dare make these tests, because the results would show that we are right. The medical profession can not admit that they do not dare to make these tests, because that would prove that the medical leaders are wrong. The medical profession can not treat us with dignified contempt, because that is confession in view of the fact that this is not a commercial venture.

If all data are released of any tests that are run, we can and will expose the faulty technique or the misunderstanding, which will probably occur in the future as it has in the past. Individual medical men have said that it would take twenty years to test our views properly. That is nonsense so far as we are concerned. If sufficient material is available, tests satisfactory to us can be made in a few months. There will come a time when the intelligent medical men—and there are such—will resent the false position into which they have been led by following the priests of Baal.

WILDER D. BANCROFT
ESTHER C. FARNHAM
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A PASTEURELLA-LIKE MICROORGANISM IN THE BRAINS OF HORSES SUFFERING FROM SO-CALLED CORNSTALK DISEASE

STUDIES at the Laboratory of Animal Pathology and Hygiene of the Illinois Agricultural Experiment Station on the etiology of an acute encephalitic disease of horses, referred to as cornstalk disease, cerebro-spinal meningitis, staggers, blind staggers, meningitis, forage poisoning, etc., which occurred in Illinois during the fall of 1934, have given consideration to the presence of filterable agents, pathogenic molds and bacteria, as well as toxic chemical substances. For the reason that such investigations require long periods of time for their completion, preliminary observations on the bacterial flora of the brains of affected horses are being reported, in part, at this time.

Animal inoculations of the brain tissue suspensions in saline of two horses, together with the inoculation of five mixed cultures made from the brains of horses, yielded pure cultures of a pathogen possessing the characters of the pasteurella group. The seven horses supplying material for these studies originated on seven different farms in three counties. In six of the seven brains, visible areas of degeneration were encountered in the cerebrum. Pasteurellosis infection has long been recognized as an etiologic factor in so-called cornstalk disease of cattle, but so far as the

writer has been able to determine, pasteurella equiseptica-like strains have not heretofore been isolated from the brains of horses suffering from so-called cornstalk disease.

ROBERT GRAHAM

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A FRESH WATER SPONGE FROM SOUTHERN CALIFORNIA

FRESH-WATER sponges are rare in California, largely because of the scarcity of permanent streams. This is especially true of so-called Southern California, south of the San Gabriel or Sierra Madre mountains. It appears, in fact, that hitherto no fresh-water sponge has ever been reported in this part of the state. On October 13, 1934, a student, Mr. Donald Nelson, found and a few days later brought to my attention such a sponge, *Asteromeyenia plumosa* (Weltner) Annandale. This is a rare species, originally described from Kinney County, Texas, and having as its only other reported locality Shreveport, Louisiana. The two Southern California specimens were each about the size of the palm of a man's hand, growing in a cement weir box which is part of an irrigation system, near Fullerton (just southeast of Los Angeles). The source of water is the Santa Ana River, which runs deep in winter, but is often dry in the summer. The specimen collected was well provided with gemmules and is typical to the most minute degree of the species as previously described.

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SCIENTIFIC BOOKS

ELECTROLYTES

Electrolytes. By HANS FALKENHAGEN, professor in the University of Köln. Translated by R. P. Bell, fellow of Balliol College, Oxford. Royal 8vo, pp. 346. $9.50. Oxford University Press.

THE motif of this comprehensive monograph is "not only to give the most important theoretical principles in the domain of electrolytes, but also to give the reader some idea of methods of experimental investigation and the reliable experimental results obtained." This statement obviously implies the notable advances made by Debye and his followers, but readers interested in topics closely allied to electrolytes will find the English translation extremely valuable.

Although the present book is for the greater part simply a translation of the 1932 German edition, it has been revised in consultation with the author to bring it into line with the experimental and theoretical advances of the past two years. The added topics embrace: theoretical and experimental work on transport numbers, Onsager's treatment of the dissociation field effect, the extension by Fuoss and Kraus of Bjerrum's theory of ion-association and finally an appendix by R. H. Fowler illuminating R. H. Gurney's application of quantum mechanics to electrode processes.

The author does not assume that, since the basic subject-matter is a time-honored one, all readers will be prepared to comprehend the intricacies of such specialized topics as those just enumerated. To this end, he devotes the first six chapters to an elementary and well-organized presentation of the problems of the equilibrium state and the irreversible process of conductance in a way which should prove helpful to one who is approaching the subject for the first time.

The thermodynamic treatment follows closely the classical methods of Planck, modified, of course, to embrace the activity concept of G. N. Lewis. Although disciples of the American and Danish schools of physical chemistry would doubtless prefer a more concise and less labored development, nevertheless the thermodynamics is eminently sound and consistent. In chapters 7 to 10, the principles of the Debye-Milner theory are developed pictorially, then mathematically and finally tested in their limiting forms as explanations of the solubility influences of ions upon ions, the salting-out effect of ions upon neutral molecules, heats of dilution and dependence of conductance upon concentration (Onsager's theory), viscosity, frequency and field strength (Wien effect).

The author has made notable contributions, in collaboration with Debye, on the intricate problem of the frequency and field strength effects, and hence is well qualified to present the subject. Although there is now available a wealth of experimental data supporting the theory in its numerous aspects, the author selects examples which not only substantiate his case but give appropriate credit to pioneer workers in the field.

The title of Chapter 11, "More Concentrated Solutions," may prove somewhat disappointing in that one who has not been dealing with the subject might expect that the concentrated solutions of industrial importance are to be discussed. As a matter of fact, the term refers primarily to that all too dilute range of concentrations for which it is necessary to consider the ion-size parameter "a" as a correction to the limiting laws—to account for the specific effects of individual electrolytes. The Hückel formula which is based upon the assumption of specific linear decrease of dielectric constant with concentration and which reproduces the experimental results of really concentrated solutions (0.1 to 4 M) is dismissed as little

more than "a convenient empirical formula for interpolation" (p. 273). This summary dismissal may eventually prove to be unnecessarily severe; nevertheless, it should operate as a warning for those writers who have been using the formula indiscriminately without cautioning their readers that the dielectric parameter has at present little or no physical significance.

The Gronwall-La Mer solution of the Poisson-Boltzmann equation, which disposes of the absurd result of "negative ion diameters"—frequently encountered in applying the original theory to high valence ions or low dielectric solvents—is presented in detail for practical application. The close relationship between the Gronwall-La Mer treatment and the Bjerrum hypothesis of ion-association is set forth rather more clearly than has been customary at the hands of some of the recent converts to the modern theory of electrolytes. The problem of "true" degree of dissociation for high concentrations is discussed in this chapter in the light of refractometric and Raman effect data, while Bronsted's "Principle of Specific Interaction" is accorded a highly appropriate presentation.

A conspicuous feature is the judicial attitude which the author assumes in presenting the work of other workers, even when they differ radically from his own views; also the complete nature of the literature references to date of publication (May, 1932). For example, the several possible interpretations of the existing e.m.f. and calorimetric data on the heats of dilution and heat capacities are presented in the light of their obedience to the limiting law and incomplete dissociation. Considering the difficulties inherent in so comprehensive an undertaking, the translator has succeeded in most instances in incorporating the more significant additions to the close of 1933.

At that time only Onsager's masterly criticism of the statistical foundations of the theory ("Symposium on Electrolytes," *Chemical Reviews,* August, 1933) was available. Since then conflicting papers by Halpern, by Kirkwood and by Fuoss dealing with the question of integrability conditions, fluctuation terms, etc., have appeared in the *Journal of Chemical Physics.* The theory is certainly not unassailable from a critical statistical view-point, yet the general excellent agreement with experiment makes it appear highly probable that these statistical weaknesses may not prove serious, after all. Under the circumstances, the author and translator undoubtedly acted wisely by deleting R. H. Fowler's earlier critique and reserving judgment on these vexing questions, even though it is done at the expense of disappointing the expert.

The reviewer has found no serious errors or misprints. The printing and format conform to the high standards of the Oxford Press. However, it is a pity that the editors of the Physics Series do not insist that their authors include an adequate subject and author index. The abridgement from the 7-page author and 4-page subject index of the German edition to the inadequate single page subject index will seriously interfere with the full use of this well-documented book as a convenient source of reference.

VICTOR K. LA MER

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REPORTS

THE ELIHU ROOT LECTURES OF THE CARNEGIE INSTITUTION OF WASHINGTON

THE establishment of the Elihu Root Lectures by the Carnegie Institution of Washington provides an opportunity for a broad outlook on science. Dedicated to a distinguished statesman well known for his appreciation of scientific research, these lectures focus attention on the influence of science upon human thought and upon our attitude toward life. For these lectures speakers will be selected from those who are eminent in their respective fields and have themselves contributed to the development of scientific thought.

The first lecture was delivered by Dr. James R. Angell, president of Yale University, on December 4. The subject was "Popular and Unpopular Science." The speaker presented an analysis of the reasons why the modern social order so readily accepts the superficial and the incorrect, and fails to appreciate or utilize the truly significant advances of science. In discussing the connection between science and the dominant forces of society Dr. Angell stated:

> . . . If science in any important sense is to affect the intellectual fabric of civilization, then through education it must be woven into the essential fabric of our culture. To do this will require at best several generations and not a few profound changes in educational method and objectives.
>
> Among other things, it will certainly mean a wide-ranging program of continuing adult education, for science grows so rapidly and its changes are so kaleidoscopic, that in no other way can adult intelligence keep abreast of its discoveries. To be sure, many individuals have intellectual limitations which will leave them inevitably strangers to the intrinsic implications of science. But limitations of this kind face all educational systems and at every level. In any case, what is really important is not so much the prevalence of accurate, up-to-date scientific knowledge as it is the ingraining, deep in the habits of thought of the people, of a careful, critical—even skeptical—scrutiny and analysis of every situation,

and with a correspondingly conservative process of inference and generalization, so that intelligence may have really free play to make its fullest contribution to the changing social order.

And in conclusion:

. . . Nor should it be forgotten that many of the highest and purest values in life lie within the area of feelng and emotion. Beauty is not the child of science, and neither its creation or its enjoyment waits upon scientific methods. The world of ethics and religion and spiritual insight is also beholden in part only to science. To impregnate our culture through education with a genuinely scientific spirit should therefore exercise no malign influence on these other integral elements of a civilization.

The second lecture was delivered on December 11, also at the U. S. National Museum, by Dr. H. A. Spoehr, chairman of the Division of Plant Biology of the Carnegie Institution, on "The Nature of Progress in Science." Dr. Spoehr illustrated the methods of scientific research by describing the steps taken in investigating the process whereby green plants under the influence of the sun's rays convert inorganic compounds into substances used by man and contrasted the mode of thought employed in the field of science and that which prevails in the field of social endeavor, saying:

Intrinsically there is no reason why there should be any difference in fundamental development in different fields of human endeavor, such as appear to be in the fields of social activity and those of natural science. They are the products of the same culture, of the same human stock and of the same stage of development. This, however, seems certain, that natural science has been tremendously stimulated by the realization that continuous change must be expected of all things and that such change is not unrelated to past experience.

He emphasized especially the necessity, in attacking any problem, of analyzing the various factors that are involved and of attempting to define these in terms of existing knowledge. To quote Dr. Spoehr:

. . . This is frequently the most difficult and discouraging stage of the scientific approach to a problem and involves a laborious and time-consuming period of fact finding and sifting of data. . . . The first step is frankly to recognize that there is a problem. This in itself involves a large element of intellectual honesty and avoids much haphazard guessing and fumbling opportunism.

Moreover, in speaking of one of the most characteristic and fortunate aspects of the development of scientific thought, Dr. Spoehr said:

The immensity of its problems has been very generally recognized by its adherents. The constitution of matter, the forms of energy, the nature of life are all subjects about which we wish to know more. But science has attacked these problems in a stepwise manner. It does not hope to arrive at ultimate truth by one master move or a single brilliant idea. It has long realized that the development of concepts is a matter of evolutionary development and it has planned its attack accordingly. One small and carefully planned advance has secured a position from which another advance could be made and so on, step by step, the development has been secure and remarkably rapid.

F. F. B.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ON d-XYLOMETHYLOSE (5-DESOXYXYLOSE)

OUR laboratory has been engaged for a considerable time in the study of methyloses. In view of a very recent publication by Swan and Evans[1] on the preparation of l-arabinomethylose (l-5, desoxyarabinose), we wish to report on the synthesis of d-xylomethylose (d-5, desoxyxylose). The sugar itself has not yet been obtained in crystalline form. The syrup, however, has the correct composition.

Calculated .... C 44.75, H 7.5.
Found .... " 44.52, " 7.5.
$[\alpha]^{20}_{D} = -2.16°$ (in ethanol).

Of this syrupy sugar three derivatives were obtained, two of which were crystalline.

(1) *Mono-acetone Xylomethylose.*
Specific rotations: $[\alpha]_D = -20.99°$ (water, c, 3.047).
$[\alpha]^{24}_{D} = -18.22°$ (U. S. P. chloroform, c, 3.046).

Melting point, 69–70°; boiling point, 86–87°/0.2 mm.
Analysis: Calculated .... C 55.17, H 8.1.
Found .... " 54.88, " 8.1.

(2) *3-Acetyl Mono-acetone Xylomethylose.*
Specific rotation $[\alpha]^{24}_{D} = +2.55°$ (U. S. P. chloroform, c, 3.136).
Boiling point, 79–80°/0.2 mm.
Analysis: Calculated C 55.55, H 7.4, CH_3CO, 19.91.
Found .... " 55.47, " 7.8, " 20.70.

(3) *d-Xylomethylose p-Bromphenylhydrazone.*
Specific rotation, $[\alpha]^{20}_{D} = -26.05°$ (dry pyridine c, 2.38).
Softens, 65°; melting point 69–70° (with foaming).
Analysis: Calculated .... C 43.58, H 5.0, N 9.24, Br 26.37.
Found .... C 43.78, " 5.1, " 9.05, Br 26.21.

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NEW YORK, N. Y.

[1] *Jour. Am. Chem. Soc.*, 57: 200, 1935.

A MERCURY PUMP FOR MAKING AND SUPPLYING A UNIFORM MIXTURE OF GASES

IN a study of the influence of gas storage upon the keeping quality of apples, the writers wished to subject small lots of fruit in five-gallon closed containers to various synthetic atmospheres; these atmospheres, varying in their percentages of oxygen and of carbon dioxide, to be supplied to the fruit at a uniform rate of flow and of concentration over any given period of time. In this experiment, where different artificial atmospheres were supplied to fruit samples without interruption over a six-month period, it was desirable to reduce the consumption of the various gases to a minimum consistent with the maintenance of uniform atmospheric conditions in the containers. The different atmospheres, containing 5, 10 and 15 per cent. of carbon dioxide and a corresponding reduction in the percentage of oxygen, were therefore supplied the containers at the rate of 100 cc each minute or only in sufficient quantity to give a complete change of air once in about six hours. This rate of exchange, which under a holding temperature of 42° F. proved sufficiently rapid to prevent the concentration of carbon dioxide in any of the containers from increasing at any time more than 0.3 per cent., required such small quantities of "air" that accurate measurement of the different gases by the use of a flow-meter presented difficulties. Thus, rather than employ this indirect method of determining volume by the measurement of differences in gas pressure, a motor-driven mercury pump was devised which accurately measured the volume of the different gases directly and supplied the resulting mixture in proper proportions to the different chambers. A diagrammatic sketch of this equipment is shown in Fig. 1.

Gas tanks, containing CO_2 and N, and the compressed air line, supplying the necessary O_2, were each fitted with the ordinary high and low pressure gauges. The latter were regulated from time to time to deliver each gas to a second regulator, a Murrill pressure controller, (a) at a pressure of from 1 to 2 pounds. After passing through this regulator, the gas flows under a 1¼ inch water pressure, as recorded by the manometer (b) to a specially designed pyrex glass pipette valve (c). In passing through the inlet valve the above pressure nearly equalizes the resistance of the mercury in the bottom of the valve; hence by the time the gas reaches the measuring bulb (d) it is at approximately atmospheric pressure.

The measuring bulbs are alternately filled with gas and mercury by the action of a 6-inch cam (e) lowering and raising a leveling bulb of mercury (f). This pumping action of the mercury is set in motion and maintained by a 1,125 r.p.m. motor equipped with a 2,200 to 1 reduction. Under these conditions one complete stroke is made and one charge of gas delivered each 2 minutes.

The measuring bulbs, also of pyrex glass, were constructed 3 inches in height and of various diameters. The bottom stem of the bulbs was of 6 mm bore and the top stem of 2 mm bore. Approximately one inch of each stem was included in the volume of each bulb. With each stroke of the pump the mercury traveled 5 inches, filling the lower stem one inch as the air was drawn into the bulb and filling the upper stem one inch as the charge was expelled. By slightly raising or lowering the level of each bulb in relation to the height of the mercury in the leveling bulb, the difference in the bore of the upper and lower stem permitted any small adjustment in volume necessary to

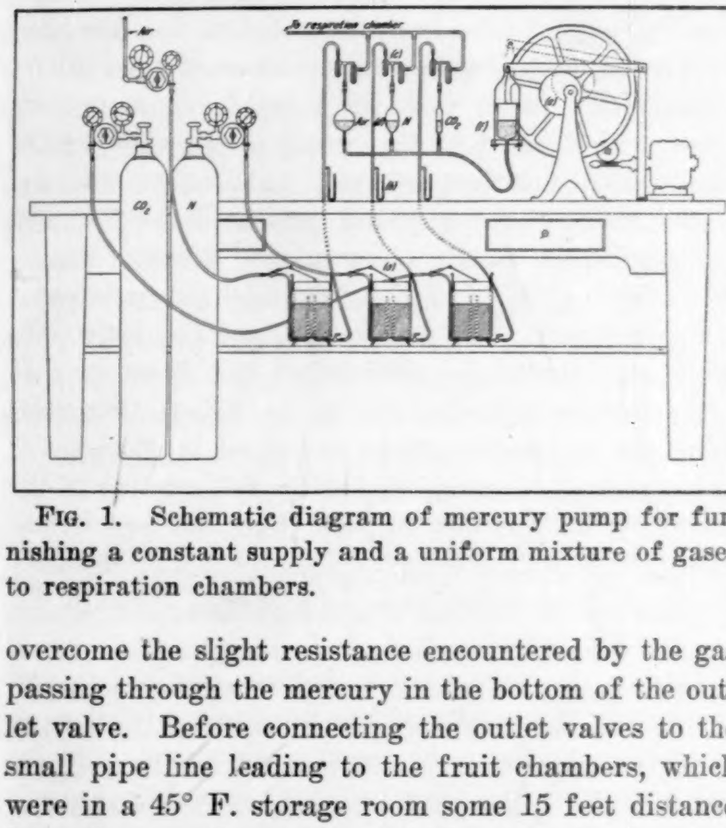

FIG. 1. Schematic diagram of mercury pump for furnishing a constant supply and a uniform mixture of gases to respiration chambers.

overcome the slight resistance encountered by the gas passing through the mercury in the bottom of the outlet valve. Before connecting the outlet valves to the small pipe line leading to the fruit chambers, which were in a 45° F. storage room some 15 feet distance from the pumping equipment, the correct volume of the bulbs was finally calibrated by displacing water in a burette. To secure a 200 cc charge of an atmosphere containing 5 per cent. CO_2 and 15 per cent. O_2, the capacity of the bulbs were CO_2 10 cc, N. 46 cc and air 144 cc.

By duplicating the cams and the series of bulbs and valves, as was actually done, any set of conditions may be duplicated. By varying the relative proportions of the bulbs measuring each gas, several different atmospheres may likewise be obtained. Changes in the gear ratio and in the actual size of the equipment make possible its adaptation to a wide range of conditions.

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SPECIAL ARTICLES

ELEMENTS AND GENERAL JUPITER PERTURBATIONS OF TEN WATSON PLANETS[1]

THE program initiated by the board of trustees in accordance with the wishes of James D. Watson for the theoretical and numerical determination of the elements and general Jupiter perturbations of the twenty-two minor planets discovered by Watson is now completed. The results for twelve minor planets are published in Memoirs, Volume X. General expressions and tables for perturbations of planets belonging to the Hecuba Group, which have a mean motion of approximately twice that of Jupiter, were published in Volume XIV, preliminary to the investigation of the Watson planets of that type. Subsequently, papers have been presented to the Academy giving the results on five critical cases of the Hecuba Group (this paper includes a brief report on two other critical cases of this group). In view of the complicated theories involved, publication was deferred until opportunity had presented itself to test the results on recent observations, decades remote from the oppositions which furnished the basic osculating elements. For the twelve planets already published, the Berlin Rechen-Institut has, from year to year, included predictions in its *Kleine Planeten*, based on the perturbations contained in Memoir X. It has already been reported at the fall meeting of the Academy at Berkeley in 1930 that the predictions have held so well, although originally limited to thirty years, that the tables have been carried forward for another fifty years.

During the past year it became possible to test thoroughly the results of the five most critical cases of the Hecuba Group by recent observations. The departures were less than had been expected theoretically, considering that the perturbations of Saturn, which may be added any time if necessary, are not included. These results have been published in abstract in the October number of the *Publications of the Astronomical Society of the Pacific*. It is now possible to report to the Academy that the value of the investigations on the Watson planets, conducted under the auspices of the board of trustees, is thus established.

In illustration of the size of the perturbations involved in these investigations I may cite one striking case, that of (175) Andromache. The perturbation for the 1935 opposition in the mean anomaly is in excess of $-26°$, which would make the disturbed position geocentrically some 52° different from the undisturbed position. For an ephemeris extending from Aug. 18 to Oct. 5 this component of perturbation, alone, changes by 1,625″. In spite of these large perturbations an observation in 1932 left outstanding differences of only $-0^{m}.32$ and $+2'.04$ although Saturn perturbations are not included. This result is the more gratifying as the last opposition on which the basic elements were based occurred in 1907, a quarter of a century before the year for which the results were tested. The recent work of testing critical cases was done under my general direction and under the more immediate direction of Dr. Sophia H. Levy by Dr. C. M. Anderson and Mrs. Barbara P. Riggs.

The ten Watson planets on which the present report is made, with their approximate mean motions as listed in *Kleine Planeten*, 1934, are: (79) Eurynome, 928″; (94) Aurora, 634″; (100) Hekate, 650″; (104) Klymene, 636″; (106) Dione, 625″; (121) Hermione, 552″; (132) Aethra, 845″; (150) Nuwa, 690″; (168) Sibylla, 572″; and (175) Andromache, 610″. On all these the work was done at Berkeley, except for (132) Aethra. For this planet, which had been lost for many years, results by another investigator have been adopted.

The following is a brief description of the principal features of the investigations for each planet:

(79) *Eurynome*, 928″: Investigations on this planet were originally made under the direction of Simon Newcomb by E. Becker, who developed general perturbations by Hansen's method on the basis of elements by Lachmann, osculating in 1884. The elements were based on eleven oppositions, 1863–81, with special Jupiter perturbations. After Becker had computed first order general perturbations with Hansen's method, representation of positions was begun by Eichelberger and revised and continued at Berkeley. The final work involved revision of the perturbations, with an improved mass of Jupiter, determination of empirical terms due to Mars, and correction of the elements on the basis of an arc of forty-six years, from 1863 to 1909.

(94) *Aurora*, 634″: Work on this planet led originally to uncertain results because of the inadequacy of available basic elements. New basic osculating elements from the oppositions 1867–1875 were made the basis of the application of the Berkeley Tables for the Hecuba Group. This process produced the desired results.

(100) *Hekate*, 650″: Investigations on this planet became complicated on account of the inaccuracy of the adopted basic elements, the slow convergence of the mean motion with successive revision of the perturbations by Hansen's method, and an unfortunate computational error. The perturbations were redeveloped on the basis of elements by Stark with Gaillot's Tables and Hansen's method. The convergence of the mean motion with revision of the perturbations was exceedingly slow, but a satisfactory value was ulti-

[1] Abstract of paper presented to the National Academy of Sciences, Cleveland, November 3, 1934.

mately obtained and was verified by application of the Berkeley Tables for the Hecuba Group.

(104) *Klymene, 636″*: Gratifying results were obtained with the Berkeley Tables.

(106) *Dione, 625″*: The difficulties involved were surmounted by application of the Berkeley Tables.

(121) *Hermione, 552″*: This planet was investigated by various methods and ultimately with the Berkeley Tables. The satisfactory outcome of the work on this planet proves that the tables are satisfactory at the extreme limits for which, theoretically, they were expected to be applicable.

(132) *Aethra, 845″*: The investigations adopted for this planet are by Hartog, who published mean elements from three oppositions, 1873–1924. The planet had been lost for nearly forty years. Hartog also published general perturbations by Jupiter from Bohlin's tables.

(150) *Nuwa, 690″*: General perturbations for this planet were developed by the Hansen-Hill method on the basis of osculating elements by Oppenheim, derived from five oppositions from 1875–1884. The final results are based on seven oppositions, from 1875–1899.

(168) *Sibylla, 572″*: With elements by v.d. Groeben, based on four oppositions from 1876–1883, the general perturbations by Jupiter and mean elements were obtained with the Berkeley Tables.

(175) *Andromache, 610″*: As referred to above, this is the outstanding case as regards magnitude of perturbations of minor planets. It was the motive for constructing the Berkeley Tables for the Hecuba Group, and was successively conquered by their application.

Thus of the planets awaiting publication, six are of the type that required the application of the Berkeley Tables in order to obtain a satisfactory representation of observations from the date of the first discovery in 1857 to the present time. Since there exist several hundred planets of this type, the way is thus clear for the development of their general perturbations as a means of long range prediction of their future positions.

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VITAMIN B_2 (G) AND CANINE BLACK TONGUE[1]

THE cause of black tongue, an acute disease of dogs characterized by stomatitis, diarrhea and frequently by a fatal outcome, remains obscure in spite of the very considerable number of experimental studies of the subject. The disease has been held in turn to be infectious, to be due to an insufficient intake of carotin[2] and to be caused by diets containing inadequate amounts of iron.[3] The most widely held hypothesis, however, has been that advanced by Goldberger and his associates.[4] They were able to cure and prevent the disease by feeding certain foods which are rich in their content of the vitamin-B complex. The effective agent in the materials fed was found to be resistant to autoclaving, a fact which served to differentiate it from the heat-labile, antineuritic vitamin B_1. It was then shown that a similar heat-stable food constituent was required for the growth of rats. Because of the similarity in distribution and resistance to heat shown by these two accessory food factors, it was inferred that they were identical. Furthermore, because of the symptomatic, geographic and etiologic likeness between canine black tongue and pellagra of human beings, the suggestion was advanced that pellagra was caused by a lack of the thermostable food factor, termed at first vitamin PP, and later vitamin B_2 or G.

Experiments have been performed in this laboratory which were designed to test, under standard conditions, the various theories concerning the cause of canine black tongue. The diet described by Goldberger as No. 114 was employed and regularly caused symptoms in from 6 to 8 weeks. Iron and carotin were both found to be therapeutically and prophylactically ineffective, but autoclaved yeast extract was entirely effective. Since Miller and Rhoads[5] had shown that the same extract was not high in its content of vitamin B_2G, and were unable to cause black tongue by feeding diets devoid of that vitamin, a direct test of the vitamin B content of the diet producing black tongue was suggested. Such a test has been made, and results show it is possible to maintain a normal rate of growth in young rats fed only the diet producing black tongue—conclusive proof that it contains vitamin B_2G in considerable amounts.

Since lack of the thermostable vitamin required for rat growth does not cause black tongue, and since the diet producing the disease contains that vitamin, it may be inferred that black tongue is not due to a deficiency of vitamin B_2G, but rather to a lack of some factor as yet unidentified.

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THE RETRACTOR MUSCLE OF THE POUCH IN THE GEOMYIDAE

THE retractor of the cheek pouch in the pocket gophers (*Geomys bursarius, Thomomys bottae, Thomomys bulbivorus*) and in the kangaroo rat (*Dipodomys spectabilis*) has been thought to represent the platysma,[1,2,3] although it is more extensive and has a more caudal origin than in other mammals. It arises, in the pocket gophers, from the superficial layer of the lumbodorsal fascia and from the last two thoracic vertebrae, superficial to and coextensive with the spinotrapezius. It runs parallel with the latter to the spine of the scapula; but, instead of attaching to the spine, it continues craniad to insert on the caudal and dorsal margins of the pouch.

The part of the muscle cranial to the scapula receives branches from the facial nerve, while the more caudal portion receives, in the four species named above, the terminal branch of the accessory. To determine whether or not the accessory nerve actually supplies the muscle, it was suggested to me by Professor A. Brazier Howell, of Johns Hopkins University, that stimulation experiments be performed. An induction coil and a bipolar electrode were used in the experiments, which were repeated in four individuals of *Thomomys bottae*. The current was the weakest that would induce contraction of the facial muscles when the facial nerve was stimulated.

The skin of the living, anesthetized animal was cut, ventral to and parallel with the retractor muscle, and deflected. This exposed the shoulder and neck region, the facial nerve and the terminal branch of the accessory. The facial nerve was stimulated near the stylomastoid foramen: the facial muscles, including the cranial portion of the retractor muscle, contracted. The facial nerve was then severed to prevent possible reflex action by it.

The terminal branch of the accessory nerve, as it emerged from the ventral border of the spinotrapezius to pass to the retractor muscle, was stimulated: the caudal portion of the retractor contracted, but none of the adjacent muscles did so. The accessory nerve was then exposed as it emerged from the jugular foramen, by cutting the origins of the sterno- and cleidomastoid muscles and of the posterior belly of the digastric. The nerve was stimulated at this point: the trapezius and retractor muscles contracted, but none of the adjacent muscles reacted. In two individuals the accessory nerve was cut distally from the place of stimulation: the retractor muscle did not contract. In two other individuals the nerve was stimulated through the trapezius: the fibers of this mus[cle] which were in contact with the electrodes contract[ed] but not the muscle as a whole, while the retrac[tor] muscle contracted as previously. The cut end of [the] accessory nerve at this place was stimulated w[ith] similar result.

These experiments appear to confirm the anatomi[cal] findings and to show that the caudal half of [the] retractor muscle of the pouch is innervated by [the] accessory, while the cranial portion is supplied by [the] facial nerve. Consequently it seems probable that [the] caudal portion has been derived from the trapezius[,] conclusion which the origin and topographical re[la]tionships of the retractor muscle tend to strength[en]. If this be true it is the only case to my knowledge [in] which the trapezius contributes to the dermal mu[s]culature.

In the ground squirrel (*Citellus richardsonii*) [the] platysma attaches to the spine of the scapula. T[he] fibers of the spinotrapezius run in the same directi[on] as those of the platysma, and the more superfici[al] ones are separated from the latter muscle only [by] fascia. Should these fibers become split off from [the] deeper part of the spinotrapezius, and should th[ey] and the platysma become free from the spine of [the] scapula, the resulting compound muscle would [be] similar to the retractor muscle of the pouch in [the] Geomyidae (in the inclusive sense). Similar chang[es] have taken place in the digastric muscles of so[me] mammals, and it seems reasonable to conclude th[at] such has been the history of the retractor of [the] cheek pouch in pocket gophers and their allies.

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